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Comfort, Performance, and Fitting in Sport-bra (Scoping view)

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Abstract

Breast pain is a common issue for athletes during exercise, leading to significant breast movement and discomfort, referring to its unsupported anatomical structure. Therefore, wearing a sports bra is crucial for women, especially during physical activity, as it provides essential support, increases comfort feel, and can prevent long-term health issues. It can also enhance physical performance by allowing efficient movement support and reducing distractions caused by discomfort. This scoping review provides a comprehensive understanding of the experiences, knowledge, and challenges associated with bra fit and sports bra participation. The search strategy was based on the Preferred Reporting Items for Scoping Reviews (PRISMA-ScR) guidelines, and multiple databases were concluded; this scoping review aimed to produce a comprehensive overview of females' experience, knowledge, and perceived challenges related to bra fit for sports participation. To the author's knowledge, the aim of this study is to develop some guidelines that help in obtaining an effective design for a sports bra.

Keywords: Sport bra Design-sport bra fit- breast support, sports bra principles.

1-Introduction

During running, the body maintains its stability through the swinging of the arms to counteract the vertical body moments imparted by the swinging legs; as shown in Fig. (1), the arm moments serve to cancel lower-limb moments of the body's vertical axis. Each arm movement is driven by the biceps and triceps, which connect with the pectoralis muscles, bringing the breasts upward with potential energy that counters the gravitational force[1] The main reason the breast motion rhythm is in an irregular linear manner was found that the *3D* breast displacement trajectories resembled a pair of closing butterfly wings, as shown in Fig. (2). The *2D* figure resembled an infinity sign shape that involved a vertical, side-to-side, and forward and backward motion as shown in fig (3)[2]

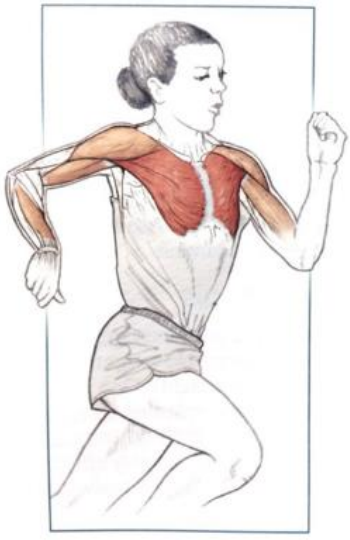

Fig (1): Arm movements while running

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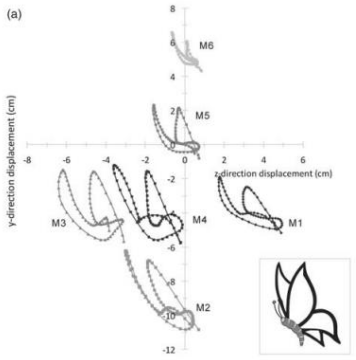

Fig (2): *3D* Breast displacement

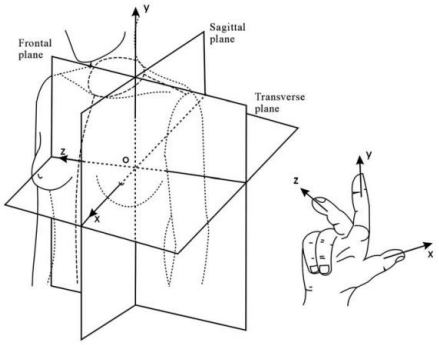

Fig (3) Breast movement axes

Unsupported breasts can be displaced about 15 centimeters while running. Approximately 50% of the movement is vertical, with the remaining 50% split equally between side-to-side and forward-and-backward movements [3]. Research indicates that during activities like running and jumping, breasts can move up and down as much as 12 cm. Each breast weighs about half a kilogram on average, and the movement can stretch the skin beyond its natural elastic range, potentially causing permanent damage [4]

Several factors affect breast motion rhythm, such as the design of the bra (compressive or encapsulating), which affects the coordination between the body and the breast [5], and the internal structure of the breast in terms of tissue stiffness and the weight of the breast itself, that affects the level of stress it undergoes during movement. Repetitive and continuous movement without external breast support can lead to breast pain, and sagging was defined [6], which proved the importance of wearing sports bras.

The first creation of the sports bra, designed by Runner Lisa Lindahl and costume designer Polly Smith in 1977 by sewing two jockstraps together, marked a significant milestone in women's history. This innovation not only transformed women's fashion choices but also played a crucial role in enhancing their breast involvement in sports. Since then, the design of sports bras has evolved considerably, leading to various iterations that have culminated in advanced versions recently. as shown in graph (1).[7], [8]

A sports bra, as one of the most popular sports-related pieces of equipment, is designed to provide essential support and comfort for women during physical activities and exercise. Primarily, wearing a sports bra during running offers significant biomechanical benefits by enhancing support and stability, improving overall running performance, and contributing to a more efficient running style [9], which meets the diverse needs of various types tailored to different individuals. The Sports bras are divided into two main categories (Encapsulation and compression; compression bras in Fig. (4) are designed to press the breasts against the chest wall, reducing movement. They are typically without separate cups and have a simple design. A bra normally features a higher neckline, designed to limit the upward movement of the breasts, along with wider shoulder straps that distribute pressure evenly across the shoulders and a larger back panel. Nevertheless, the compression exerted on the breasts may lead to discomfort and alter the natural shape of the breasts. Conversely [10], [11]

Fig (4): Compression sports bras

An encapsulation bra in Fig (5) is designed to surround each breast individually using separate cups, providing individual support and reducing movement in all directions consisting of a gore and two separate cups. The gore serves to divide the breasts, while the cups secure them in position, resulting in less distortion of breast shape. However, the gore cannot be positioned too high, which means that an encapsulation bra offers less control over upward breast movement compared to a compression bra. Nonetheless, a sling can be incorporated at the side of the inner cup in an encapsulation bra, which is considered more effective in restricting lateral breast movement. [12], [13]

Fig (5): Encapsulation sports bras

The ideal standards for fitting sports bras are essential for minimizing discomfort and improving athletic performance. Studies suggest that a properly fitted sports bra must achieve a balance between pressure force, thermal comfort, and sufficient support. To cater to different breast sizes and shapes [14], the assessing points of sports bra Fitting are involved: **Band Fit:** The underband must be positioned evenly around the chest, delivering the primary support. It should be neither excessively tight nor overly loose; ideally, it should permit a comfortable deep breath without shifting upward or pressing into the skin [15]. **Cup Fit:** The breast mass should be fully covered and help determine its position without causing bulges around it, as this indicates pressure on the breast and a small cup size. Conversely, the presence of air gaps means that the size is too large [16]. **Strap Fit:** The straps should rest gently on the shoulders, avoiding any slipping or pinching. An appropriate fit allows two fingers to fit comfortably between the strap and the shoulder [17]. **Back band: The** band should have Comfortable tightness to provide enough support without making the flesh bulge over the top of the band or slip during movement. Suitable tightness reduces friction, keeping the band in place during movement [18]

Sports bras are more studied than regular bras; they allow the breasts to move in unison with the trunk, individually, as designing an effective sports bra involves navigating a multitude of complex factors that influence both comfort feel and performance. Key considerations include anatomical variations, material properties, and the specific needs of different user groups. Therefore, this scoping review aims to provide a comprehensive understanding of experiences, knowledge, and perceived challenges relating to bra fit and sports participation.

2-Methodology: -

2.1. Design and search strategy:

The search strategy was developed based on the Arksey and O'Malley (2005) framework for scoping reviews [19], and the relevant studies were reviewed according to the established inclusion and exclusion criteria. This method enabled a thorough review of the research to gain a deeper understanding of the basics of sports bra design.

2.2. Suitability criteria:

Studies were included if they discussed the effect of the type of sports bra on breast movement during sports activities or running on a treadmill. They evaluated the effectiveness of various parts of sports bras in providing support. The studied sample consists of girls or women who do not exceed 30 years old and who are neither pregnant, breastfeeding, nor in their menstrual period. Within the last 10 years (2004–2024), A total of 27 studies were screened, and five studies were removed. The remaining 22 studies were included in this scoping review.

2.3. Study characteristics:

The main theme and focus of the studies was to determine which type of sports bra was most suitable for reducing breast movement during physical activity. The evaluation was based on two parts: one related to breast movement and the other related to comfort while wearing the sports bra, and studies were to identify the effect of the components of bras on the feeling of comfort and their role in the process of supporting the breast during movement **fourteen studies used quantitative methods** to measure breast motion and breast support (J.L. White1, J.C. Scurr1, and N.A. Smith.2009; Joanna C. Scour a, Jennifer L. White, a & Wendy Hedger2010; Jennifer White, Joanna Scurr, and Wendy 2011; Parun Chaya Jamkaran, Weerawat2015; Chris Mills, Amy Loveridge, Alexandra Milligan, and Joanna Scurr 2015; Jie Zhou1, Winnie Yu1a, Sun-Pui Ng1, and Jack Hale2015; Wang Erhu, Wang Yanzhen2017; Lindsey Ungerman 2018; Xiaona Chen* Guangwu Sun Jianping WangYanmei Li1 Hong Xi 2021-Jie Zhou1, Winnie Yu2 and Sun-pi Ng2013; Donna Branson, Oklahoma2015; Y Sun1, KL Yick1, PL Li1, M Tang2021; Afsaneh Valipouri1, Fariba Salmani 2021). **Eight studies used qualitative methods** (Deirdre E. McGhee).2009; K-A Bowles, J R Steele, B Munro 2013; Xiaona Chen, Sheridan A. Gho, Jianping Wang & Julie R. Steele 2016; Francisca Margarita Ocran, Xiaofen Ji and Lina Zhai 2022- Kelly-Annbowels2012; Brown, Nicola; White, Jennifer; Brasher, Amanda2014; Kaixuan Liu, Lingxi Zhang, Chun Zhu2019; Michelle Norris, Tim Blackmore2020) The sample of the studies included 282 from girls and women, 1153 athletes, variety of

breast sizes and cup sizes across the studies ranged from A to DD, with an average age of 20-30 years. Five studies evaluations were conducted while running outdoors at different speeds. It consisted of seven participants. Where they ran on the electric treadmill at three different speeds (5, 7, and 9 km per hour), and

one session included a questionnaire directed at the female athletes. Eight studies evaluated the compressive and encapsulated sports bras, while two studies examined more than one design for them, and three studies have proposed a new design in addition to the previous two types.

3 Results:

Evidence from the literature suggests two directions. The first is a focus on breast movement during physical activity under different breast support conditions, as shown in Table (1), and the second is surveys to identify the effect of the components of bras on the feeling of comfort and their role in the process of supporting the breast during the movements shown in table (2).

Table 1. Summary of Studies that evaluated the compressive and encapsulated sports bras

The name of the researcher and the year of publication	The sample	The experimental trial	The results
J.L. White1, J.C. Scurr1 and N.A. Smith, [20]	8 female participants, average age: 22 years, breast implant sizes	Outdoor running with reflective markers attached to the upper torso and breasts, and participants running with different methods of breast support (bra less, compressive sports bra, and encapsulated sports bra).	The results showed significant differences between sports bras and regular bras compared to not wearing a bra. The regular bra reduced breast movement by 40%, while compressive sports bras reduced it by 60%, and encapsulated sports bras reduced it by 56.6%.
Deiredre E. Mcghee, [21]	20 participants, average age 25 years and breast cup sizes-DD	The participants chose their own speeds for walking and running on the electric treadmill, so they could continue for three minutes at each of the five stages. The average walking speed was 3 km per hour, and the running speed was 8 km per hour. After each stage, the participants were evaluated for discomfort through a questionnaire, and breast movement was measured using reflective markers attached to the breasts. Two types of sports bras were used: encapsulated sports bras available in the market and a trial sports bra that combined lifting and compressive feature	The study found that combining lifting and compressive features significantly reduces discomfort and excessive breast movement during physical activity compared to standard encapsulated sports bras. it is recommended that further improvements in the design of sports bras, studies are required, considering the differences in cup sizes
Joanna C. Scour a, Jennifer L. White, & Wendy Hedger,[22]	21 participants, average age 22 years, breast cup size D and larger	Running on the electric treadmill, starting speed is 5 km per hour and increasing to a speed of 15 km per hour in two support conditions (compressive sports bra and encapsulated sports bra), with three reflective markers attached to the breasts and upper torso	The study found no statistically significant differences between the two types of sports bras in terms of breast movement support; However, the study supports the use of encapsulated sports bras for larger cup sizes and recommends that future research should determine multiple breast movement patterns during various physical activities. This could lead to the production of a specialized sports bra to reduce the negative effects of breast movement and combine the advantages of both types of sports bras

Table 1. (Continued).

Scurr JC, White JL, Hedger, [23]	6 participants, average age: 24 years, breast cup size D	-Outdoor running -Running on the electric treadmill at a speed of 3 meters per second, determining breast movement using infrared cameras by attaching reflective markers to the breasts, and participants completing the exercises using different methods of breast support (bare less, regular bra, compressive sports bra, and encapsulated sports bra)	This study found that three-dimensional breast movement and breast discomfort feel did not differ between running on the electric treadmill and outdoor running. Determining whether one type of sports bra is more effective than other difficulties, as the types of sports bras did not show a clear difference in the amount of support provided for both types of running.
K-A Bowles, J R Steele, B Munro, [24]	413 subscribers Average age 20-35 Breast size from A-DD	A questionnaire was distributed online to the participants, and some phone calls were made to learn about the opinions of women regarding the support they need during physical activity.	The study found that individuals with smaller cup sizes do not prefer wearing encapsulated sports bras, unlike those with larger cup sizes. This is due to the level of discomfort feeling during movement when wearing compressive sports bras
Parunchaya Jamkrajang, Weerawat, [25]	30 participants between the ages of 22-27 years	Running on an electric treadmill using three speeds of 3/6/9 km/h, and 4 light-reflecting signs were placed on the breasts and upper torso. The test was conducted on three cases (bra less - compression bra – encapsulated bra)	The study found that the compressive sports bra prevents excessive breast movements, but it can cause discomfort due to the pressure on breast tissue. On the other hand, the encapsulated sports bra provides comfort but may not be as effective in reducing breast movement. The study recommended the need to develop a sports bra design that combines the advantages of both types."
Chris Mills, Amy Loveridge, Alexandra Milligan and Joanna Scurr, [26]	12 participants, average age: 23 years, breast implant size B-C-D	Running on the electric treadmill for five consecutive cycles with eight reflective markers attached to the breasts and upper torso, tracked by infrared cameras. Sports methods were used to calculate trunk movement, and six different types of compressive sports bras were tested.	The study found that these sports bras reduce breast movement in smaller cup sizes and do not cause excessive discomfort when increasing physical activity. However, they do not affect breast movement in larger cup sizes and can cause discomfort due to the pressure on breast tissue, confirming that compressive sports bras are not suitable for larger cup sizes.
Jie Zhou1, Winnie Yu1a, Sun-pui Ng1 and Jack Hale, [27]	3 participants who practice sports, aged 24-29, breast size B-C	"Using the electric treadmill and performing three activities (walking, running, and jogging), using the Vicon system to record breast movement and identifying six points on the breast skin. Two types of compressive sports bras and two types of encapsulated sports bras were tested.	The study found that the encapsulated sports bras (EP.2) provided lower values of breast movement during physical activity, indicating that they were better at absorbing breast shock. However, they did not significantly reduce breast movement with increasing exercise intensity. On the other hand, the compressive sports bras (CP.3) provided lower values for breast movement with increasing speed in smaller cup sizes. Therefore, the study recommended the need to design a sports bra that combines the advantages of both types

Table 1. (Continued).

Xiaona Chen, Sheridan A. Gho, Jianping Wang & Julie R. Steele, [28]	21 participants aged between 25-24 years and had breast implant measurements A-B-C	Running on the electric treadmill at 5/7/10 km per hour, the test was conducted in two conditions (compressive sports bra and encapsulated sports bra). The evaluation was done by providing questionnaires to the participants after each stage and comparing the results of the questionnaire in the case of consistency	The study concluded that it is not possible to prefer one type of sports bra over the other in all cases. The study recommended the encapsulated sports bra for cup size B or smaller, while for larger sizes, the compressive sports bra was recommended despite the discomfort it may cause. The study recommended the need for further research to determine ways to modify the design of sports bras, especially straps, to provide adequate breast support without causing discomfort
Wang Erhui, Wang Yanzhen, [29]	2o Participants average age is 25 years	Different activities were identified based on their intensity level (low-intensity activities, moderate-intensity activities, and high-intensity activities). A specific design for the sports bra was determined, and the pressure ratio that affects the body was identified.	The study found that the higher-pressure level and flattening of the breast on the chest, the lower the frequency of breast movement during physical activity. However, this can cause discomfort and lack of comfort even during rest, and with increasing physical activity intensity, it can also cause an increase in body temperature. The study recommended the need for a sports bra design that includes breast mass.
Lindsey Ungerman,[30]	11 participants aged between 10-30 their breast cup size-DD	Short-term running divided into six trials, with speed determined according to the participants' self-selection. An accelerometer was placed in front of the right nipple after each trial, and discomfort was evaluated using a digital scale for pain intensity. The trials were conducted with three types of support (compressive sports bra, encapsulated sports bra, and a hybrid sports bra that combines both types)	The study found individual differences in perceived comfort between different types of sports bras, which can be attributed to cup size and activity intensity. The compressive sports bra was evaluated as less comfortable than the encapsulated sports bra, but it was better at reducing breast acceleration than the encapsulated sports bra. However, the hybrid sports bra design was not good enough, and the participants reported that it was too tight and uncomfortable. Therefore, the study recommended the need to work on developing a good design for the hybrid sports bra or trying to control the defects of each type of sports bra
Xiaona Chen* Guangwu Sun Jianping WangYanmei Li1 Hong Xi, [31]	15 participants, average age between 24-29 years, and breast cup sizes ranging from A-c	Running on the electric treadmill at three different speeds (5, 7, and 9 km per hour), with four markers placed on the breasts for motion tracking.	The study found no statistically significant differences between the two types of sports bras in smaller cup sizes in terms of breast movement. For larger cup sizes, encapsulated sports bras were preferred at speeds of 5-7 km per hour, while compressive sports bras were preferred at

			higher speeds. However, the compressive sports bras caused discomfort and pain after exercise
Francisca Margarita Ocran, Xiaofen Ji and Lina Zhai, [32]	20 participants, average age 23-29 years old, breast cup size-c	Wearing two types of sports bras during outdoor running and golfing, and a questionnaire was designed for female athletes after performing the exercises. The questionnaire was based on evaluating the problems they faced during movement and assessing comfort on five points: shoulder straps, lower band, back band, back design, and closure method.	The study found that encapsulated sports bras provide more comfort when worn and cause less pressure on the body compared to compressive sports bras. However, the questionnaire results revealed some problems faced by the participants in both types, The study recommended the need to pay attention to the design of sports bras and consider the points that cause problems for female athletes.

Table 2. Summary of Studies that measure the effect of the components of sports bras

Name of the researcher and year of publication	The sample	The experimental trial	Results
A Kelly-Annbowels,[33]	430 participants whose average age was (20-30).	Design a questionnaire and send it by email to identify the problems facing female players	The study found that the most common problems that participants suffer from are (excessive pressure of the shoulder strap - excessive pressure on the breast cup, which leads to a feeling of discomfort and shortness of breath) Although it limits movement, it causes a feeling of pain. The study recommended the need to come up with a design to support the breast. Without relying on pressure.
Jie Zhou1, Winnie Yu2 and Sun-pi Ng, [34]	4 participants, average age 24 years	Measuring breast movement relative to the chest using a system3D-VICON is based on determining the three-dimensional displacement of the breast, placing 6 marks on the breast and torso, and walking and running on an electric treadmill while wearing 7 different types of chest girdles, 2 compressive and 5 encapsulated	The study found that there were significant differences in breast displacement and movement between the 6 brands in each type of bra, and the decrease in breast displacement was mainly related to several points: (width of the shoulder girdle - height of the neckline - depth of the sideline). The study also discussed breast movement. He set some points that must be taken into consideration while designing a sports bra, which are (the gap between the breast and the neckline - the area of the side - the width of the shoulder belt - not using wires).
Brown, Nicola; White, Jennifer; Brasher, Amanda, [35]	1,279 runners of the 2012 London Marathon of various sizes	Designed a questionnaire consisting of 30 questions and presenting it to the participants. Among the topics of the questionnaire were identifying the problems facing mathematics and learning	The study concluded that despite awareness of the importance of using sports bras, 49% of the research sample rated bras as inappropriate, and 75% reported that there are problems they face when wearing them, such as (excessive pressure on the breast tissue - digging into the bra

		about the experiences of breast pain and its impact on performance	strap). Shoulders: These problems were more apparent with participants who had large breasts, and participants reported that a wide shoulder belt was more comfortable and effective for them.
Donna Branson, Oklahoma, [36]	6 participants, average age 23 years	Comparison between two types of sports bras available in the market and an experimental bra that was developed to support the breasts through a laboratory study to record a video of the movements made by the participants while running while wearing each type of bra.	The study concluded that compression with packaging gives more support for the movement and recommended the necessity of working to find innovative and more effective designs. It also reached some other points such as (shoulder belt width - overlapping of back straps - use of materials with low stretchability - non-stretchable shoulder straps)
Kaixuan Liu, Lingxi Zhang, Chun Zhu, [37]	31 participants with a variety of breast sizes and breast shapes, with an average age of 25 years	Experienced with 11 sports bras available in the market, evaluated in four stages (before wearing - after wearing - after engaging in activity - comprehensive evaluation)	The study concluded that the factors for evaluating the basic comfort of sports bras using a factor analysis method were (shape - comfort - stability), and for small sizes we add a factor (method of wearing), and in medium and large sizes we add a factor (comprehensiveness - breast firmness). It was also concluded that the level of sensation Comfort and support differ between different sizes, and the following points explain them: - 1- The width of the shoulder strap: The large size requires a width of the shoulder strap to bear the weight of the breast, while it is not an essential factor for small sizes and is a moderately important factor for medium sizes. 2- The breast mold's inclusion of the breast mass: It was an important element for large and medium sizes, respectively, and essential for a sense of comfort and support, and it was not a problem for small sizes because of the ease of achieving it. 3- The intersection of the shoulder strap: It caused inconvenience for large and medium sizes due to the weight of the breast, while for small sizes it was better for supporting breast movement. The study recommended the need to take into account the shape of the breast when designing bras, in addition to movement and comfort of wearing.

Michelle Norris*, Tim Blackmore, [38]	77 participants, average age was 22 years, and breast implant size ranged from (B-D)	It evaluated 98 sports bras available on the market, and they varied between (light, medium, and high support). The evaluation was based on the characteristics of typical sports bras, and then they were tested while running on an electric treadmill by the participants.	Through testing previous designs, the study reached some points that must be studied and worked on as they help improve the performance of sports bras, which are (width of the straps - height of the neck of the corset - lack of padding - lack of wires - use of nylon materials)
Y Sun1, KL Yick1, PL Li1, M Tang, [39]	4 participants, average age of 25 years, sizes (38C-44C)	Testing 12 types of chest braces while running and walking on an electric treadmill at two speeds (4km-6km/hour) and recording breast movement with a system. VICON	Through analyzing the movement results of the different designs, the study reached several points that mainly contribute to supporting the breast and controlling its movement, which are (the size of the breast mold - the distance between the breasts - the percentage of expansion in the shoulder girdle).
Afsaneh Valipouri1*, Fariba Salmani, [40]	From a 25-year-old subscriber, size 38C	Two types of testing bras are available in the market. The first type does not contain seams and consists of one layer without adding cups and does not contain seams. The second type contains cuts and consists of two layers and contains cups. A metal thread was added to connect the previous two types to determine the pressure on the body, and three places were identified. For stitching (shoulder strap - under chest - back strap)	The study concluded that during physical movement during sports activities, changes occur in the chest corset in terms of length or pressure on the material, and the most affected places are (shoulder girdle - lower chest). The study recommended the necessity of supporting these areas in the corset so that they can support the breast.

Evidence from the literature of previous studies, there was no preference for any type of basic sports bra design (compression-encapsulated) over the other, and both contained some advantages and disadvantages, and consumers' opinions differed about that. Many studies have agreed that the breasts move in three levels of movement during exercise. Due to its nonlinear material properties, bras that contain useful cups are more effective in reducing the overall movement of the breasts during exercise, because bras that contain cups reduce movement in two of the three levels, while compression bras reduce movement in only one level [41] This is also due to the difference in sizes and intensity of sports activity, but what all previous studies recommended. So, it is necessary to work on designing a combination sports bra that combines the characteristics of compression. The design of this sports bra is more effective because it combines the advantages of both sports bra.

Regarding the second part of the studies, it was found that the sports bra component that most registered the highest levels of dissatisfaction with their functional performance among users has been identified. **The cup** doesn't fully contain the breast while at rest, which results in the breast coming out of the cup during physical activity. Alternatively, it may put excessive pressure on the breast, causing pain. A low neckline results in a lack of support for the breast from above during vertical movements. **Band,** Excess pressure on the body, Lack of ability to judge the movement of the breast from below, Roll the tape up as you move. **Shoulder straps**, Drilling on the shoulders, sliding off the shoulder**,** work to suspend the breast, not lift it.

4-**Discussion:** -

The current study reviewed the pattern block methods of sports bras and found that it is difficult to combine two types of sports bras. This is due to the significant differences in their construction methods. Compression sports bras rely on flattening the pattern and the elastic properties of the fabric to achieve their functional performance. In contrast, the other type relies on using contouring methods to separate the

breasts and define the shape of body parts around the bra. The study concluded that it is possible to modify the characteristics of each type separately to meet consumer needs.Click or tap here to enter text.

- firstly, an encapsulated sports bra has some basic adjustments for each part of it according to the function it performs that must be followed when developing its functional design. Modify the cup size to fully contain the breast mass from all directions in a state of rest To control the horizontal bounce of the breast during physical activity, The strap should be in the middle of the cup to help lift the breast mass in a balanced way, Increase the width of the strap to distribute the weight of the breast evenly on the shoulder without feeling pain and size of the strap should be proportional to the size of the breast cup, and the relationship between them should be directed, Bra band Increase the width of the under band to enhance breast support from below, control breast sagging, and also help stabilize garment on the body during movement and It should take a semi-circular shape from the bottom of the breast so that it fits with its anatomical shape. This helps to avoid gaps between the clothing and the body and thus contributes to the lifting process, center piece Increase the height of the center front piece, as it helps to cover the breast mass better and reduce breast oscillation during movement. And making it clear in design so that we can separate the two breast masses from each other and support each of them separately, it should take a semicircular shape in the direction of the breast mass, side piece Increase the width of the side of the bra to support the breast from the side, and the shape of it pattern block must be in line The shape of the breast from side to limit the dispersion of the breast in the side direction.

-Secondly, compression sports bra Excessive pressure on the breast mass was the main problem with, so the current study attempted to divide the pattern block into areas and define the functional purpose of each. They were as follows; the parts responsible for support are represented by the area surrounding the breast mass from above down to the apex line. The compressive parts are represented by the breast cup area. The parts that combine lifting and support are represented by the area below the breast mass the adjustments through the following points: -

1- Distribute the pressure around the breast mass by Using supportive and compressive materials outside the boundaries of the breast mass to limit the transmission of movement through the ligaments connected to the breast.

2-Define the pressure area specific to the breast in a manner that is appropriate to the shape of the breast and since the shape of the breast is hemispherical, relying on a method of compressing the breast mass to contain it, then compressing it, rather than flattening it without accommodating its dimensions achieve good control of it without feeling pain.

3- the area below the breast mass should take a semi-circular shape from the bottom of the breast so that it fits with its anatomical shape. This helps to avoid gaps between clothing and the body, and this contributes to the lifting process. The size of the band should be proportional to the size of the breast cup.

Conclusion:

The current study benefited from analyzing the results of sports bra design studies in developing a mechanism of designing bras that must be worked on, to arrive at an effective sports bra design that enhances breast support and limits its movements. The study noted that the points extracted from previous studies are broad lines of the design left to the designer's personal expression. These findings are expected to illustrate new guidelines with the anatomical nature of the breast. It is intended to be applied during the model-building stage. The initial step to obtain an effective functional performance of the garment is to translate the functional performance of the garment into the initial design, and the dimensions of building the model.

Recommendations:

Work on developing designs for sports bra that follow the guidelines derived from research and measure the impact of modern designs on the efficiency of the sport bra and its ability to support the movement.

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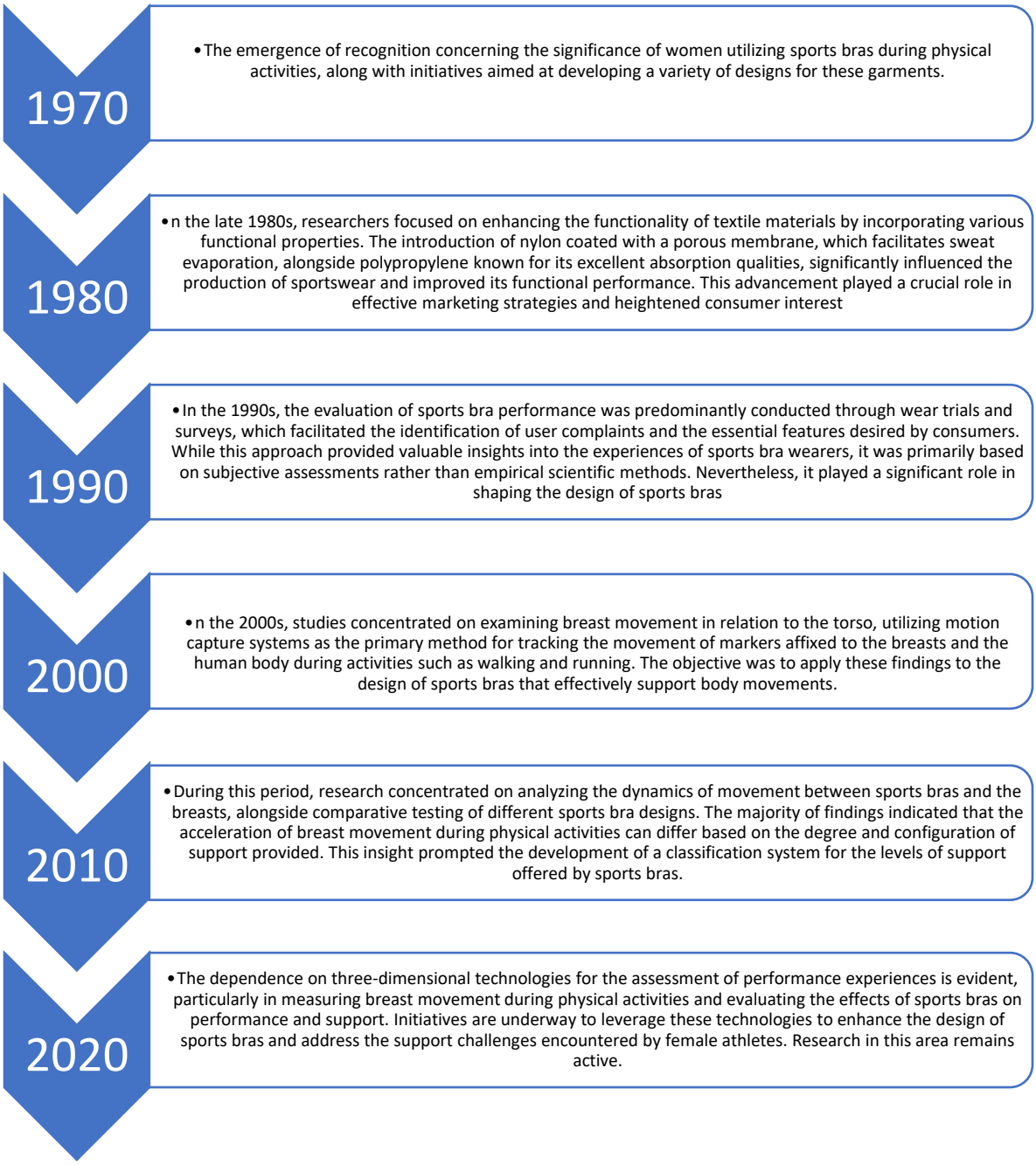

Graph (1) The evolution of sports bras throughout history

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الراحة، الأداء، والضبط في مشدات الصدر الرياضية (نظرة استكشافية)

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الملخص

يُعد ألم الثدي مشكلة شائعة لدى النساء الرياضيات أثناء ممارسة الأنشطه البدنيه، إذ تؤدي إلى حركة ملحوظة للثدي وشعور بعدم الراحة، ويرجع ذلك إلى البنية التشريحية للثدى لعدم أحتواءه على دعم. لذلك، يُعتبر ارتداء مشدات الصدر الرياضية أمرًا بالغ الأهمية للنساء ، حيث توفر الدعم اللازم، وتزيد من الشعور بالراحة، ويمكن أن تمنع المشكلات الصحية طويلة الأمد. كما يمكن أن تعزز الأداء البدني من خلال الدعم الفعال الحركة وتقليل التشتت الناتج عنه الشعور بعدم الراحة. تقدم هذه الدراسه فهمًا شاملاً للتجارب واالمعارف والتحديات المتعلقة بمشدات الصدر الرياضيه . وقد تم اعتماد استراتيجية البحث وفقًا لإرشادات عناصر المراجعات الاستكشافية(PRISMA-ScR) ، وتمت مراجعة عدة دراسات سابقه وفقا لها. لتقديم نظرة شاملة حول تجارب النساء ومعرفتهن والتحديات المتصورة المتعلقة بمشدات الصدر الرياضية. ، فإن هدف هذه الدراسة هو تطوير بعض الإرشادات التي تساعد في الحصول على تصميم فعّال لحمالة الصدر الرياضية.

الكلمات المفتاحية: مشدات الصدر الرياضية، ضبط مشدات الصدر الرياضية، دعم الثدي، اساسيات مشدات الصدر.